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ABSTRACT

This module on research design in vocational education is one of a set of five on evaluation and research and is part of a larger series of thirty-four modules constituting a core curriculum for use in the professional preparation of vocational educators in the areas of agricultural, business, home economics, and industrial education. Following the module objective and overview and a bibliography of suggested resource materials (readings) for the entire module, five lessons are presented: (1) introduction to statistics--properties of data and measures of central tendency; (2) correlation and prediction; (3) laws of probability and strategies of inferential statistics; (4) hypothesis testing--parametric statistics; and (5) hypothesis testing--nonparametric statistics. Each lesson contains the objective, overview, a list of suggested learning activities, and a list of suggested resources (readings). Concluding the module is a pre/posttest and an answer key. (The modules have been field tested in various educational settings, including bachelor and masters degree programs, and are considered adaptable to many instructional styles and student entry levels. CE 018 935-937 contain working papers and other materials used in the development of the module series.) (JH)

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Common Core Curriculum
for Vocational Education

G-4

RESEARCH DESIGN IN VOCATIONAL EDUCATION

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Category G:

EVALUATION AND RESEARCH

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EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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ABOUT THIS MODULAR CURRICULUM

This module is one of a series of 34 modules intended for use in the professional preparation of vocational educators in the vocational education service areas of agricultural, business, home economics, and industrial education. The curriculum can be adapted to various styles of instruction and to various entry-levels of students.

It is recommended that an instructor planning to use these modules review each category to determine if any modification is needed in the objectives and suggested activities so that they conform with local institutional policies and/or vocational education programs. It is also suggested that resources and activities be identified for the specific entry-level of the student to be served.

The activities listed are suggested. The use of any other activity or reading reference which the instructor believes would help to accomplish the objectives of that lesson is encouraged. The choice of the teacher to use the entire module, either through group reports or individualized assignment, will be related to individual student competency requirements.

Since many modules strongly recommend the use of local administrative personnel and community rsources, it is suggested that all site visitations and requests for assistance in the community be coordinated by or cleared through the instructor. The instructor may wish to distribute these tasks among the student group and across the community with the class report system being used to disseminate the information gathered.

These modules have been field tested in various settings. They have been used with students working toward a bachelor's or master's degree and with students seeking the designated subjects credential in Californica. Some modules were tested through student independent study, others as part of total class assignment, and still others as an alternate activity. Workshop participants examined the materials in terms of content, activities, and resources. The adaptability of this curriculum is one of its strengths.

The materials could not have been completed without the participation and contribution of many individuals. Chief among these persons were the module writers, workshop participants, field-test instructor, and students. Conference presentors and evaluators also contributed to this project. Proceedings of the workshop are available upon request.

If we can provide you with information or help in using this curriculum, please feel free to contact us.

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COMMON CORE CURRICULUM

FOR

VOCATIONAL EDUCATION

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TABLE OF CONTENTS

Module Objective. . . . . Page 1
Module Overview 1
Resource Materials for Completing the Activities in this Module . . 3
Lesson One: Introduction to Statistics: Properties of Data and Measures of Central Tendency 4
a. Objective 4
b. Overview. 4
c. Suggested Activities. 4
d. Suggested Resources 5
Lesson Two: Correlation and Prediction 7
a. Objective 7
b. Overview. 7
c. Suggested Activities. 7
d. Suggested Resources 8
Lessor Three: Laws of Proability and Strategies of Inferential Statistics 9
a. Objective 9
b. Overview. 9
c. Suggested Activities. 9
d. Suggested Resources 10
Lesson Four: Hypothesis Testing - Parametric Statistics. 11
a. Objective 11
b. Overview. 11
c. Suggested Activities. 11
d. Suggested Resources 12
Lesson Five: Hypothesis Testing - Nonparametric Statistics 13
a. Objective 13
b. Overview. 13
c. Suggested Activities. 13
d. Suggested Resources 14
Module Pre/Posttest 15
Answer Key. 22

RESEARCH DESIGN IN VOCATIONAL EDUCATION

Module Objective

Upon the satisfactory completion of this module, the student preparing to become a teacher of vocational subjects will be able to identify and describe statistical procedures for gathering, organizing, analyzing, interpreting, and reporting research data.

Module Overview

The vast majority of the professional literature in the behavioral sciences includes results that are based on statistical analysis. Statistics is not just a catalog of procedures and formulas; it offers the rationale upon which most of behavioral science research is based. If members of the teaching profession are to receive the maximum benefit from their own research efforts as well as from research reported in the literature, it is essential that they have a basic comprehension of statistical procedures.

George J. Mouly in The Science of Educational Research, 1970, points out that if research is to be productive, the plans for analysis must be laid at the time the study is selected and designed. Unless the analysis of the data can be made sufficiently precise to permit interpretation and generalizations, there is no point in conducting the investigation.

It should be emphasized that processing of numerical data through statistics mandates a certain level of competence in the use of statistics, an awareness of assumptions that are appropriate, and also an awareness of the strengths and weaknesses of various statistical designs.

The research worker who uses statistics is concerned with more than the manipulation of data. Statistical method goes back to the fundamental purpcses of analysis. The proper application of statistical method involves answering the following questions:

(1) What facts need to be gathered in order to provide the information necessary to answer the questions?

(2) How are these data to be gathered, organized, and analyzed in order to throw light upon the problem?

(3) What assumptions underlie the statistical methodology that is employed?

(4) What conclusions can be logically drawn from the analysis of the data?

The central thrust of this module is to help the student understand the rationale for descriptive and inferential statistics and applications of these procedures in research. The specific lessons of this module are:

(1) Introduction to Statistics: Properties of Data and Measures of Central Tendency

(2) Correlation and Prediction

(3) Laws of Probablility and Strategies of Inferential Statistics

(4) Hypothesis Testing: Parametric Statistics

(5) Hypothesis Testing: Nonparametric Statistics

Resource Materials for Completing the Activities in this Module

Best, John N. Research in Education. Englewood Cliffs, New Jersey: Prentice-Hall, 1970.

Borg, Walter R., and Meredith D. Gall. Educational Research. New York: David McKay Company, 1971.

Freund, John E. Modern Elementary Statistics. Englewood Cliffs, New Jersey: Prentice-Hall, 1973.

Krahmer, Edward, and Clyde Morris. Reading and Evaluating Educational Research. New York: Macmillan, 1974.

Li, Jerome C. R. Statistical Inference. Ann Arbor, Michigan: Edwards Brothers, 1964.

McCollough, Celeste, and Van Atta Loche. Statistical Concepts. New York: McGraw-Hill, 1963.

Mouly, George J. The Science of Educational Research. New York: Van Nostran Reinhold, 1970.

Naiman, Arnold and others. Understanding Statistics. New York: McGraw-Hill, 1972.

Popham, James W., and Kenneth A. Sirotnik. Educational Statistics Use and Interpretation. New York: Harper and Row, 1973.

Schmidt, Marty J. Understanding and Using Statistics Basic Concepts. Lexington, Massachusetts: D. C. Health, 1973.

Spence, Janet T. and others. Elementary Statistics. New York: Appleton-Century-Crofts, 1968.

Welkowitz, Joan and others. Introductory Statistics for the Behavioral Sciences. New York: Academic Press, 1971.

RESEARCH DESIGN IN VOCATIONAL EDUCATION

Lesson One: Introduction to Statistics: Properties of Data and Measures of Central Tendency

Objective

Upon the satisfactory completion of this lesson the student will be able to identify basic properties and applications of descriptive statistics.

Overview

One of the primary purposes of statistics is to summarize or describe the characteristics of a set of data in a clear and convenient fashion. The simplest type of statistical techniques which are used for this purpose are referred to as descriptive statistics. This statistical process can be described as a method of taking data in numerical form, applying computational procedures and coming up with a single number or a few numbers that tell something about the set of data as a whole.

It should be remembered that statistics is the servant, not the master, of logic. Unless basic assumptions are valid, unless the right data are carefully gathered, recorded, and tabulated, and unless the analysis and interpretation are logical, statistics can make no contribution to the search for truth.

The specific purpose of this lesson is to achieve an understanding of:

(1) Methods of organizing and reporting data

(2) Measures of central tendency, i.e., mean, median, and mode

(3) Measures of position and dispersion, i.e., range, standard deviation, percentile, sigma scores, and standard scores

Suggested Activities

(1) Discuss three factors that influence the interpretation of any statistic: (a) source of data, (b) choice of the correct statistic, and (c) appropriate presentation of the statistics.

(2) Define and explain the difference between descriptive and inferential statistic.

(3) Prepare a table of hypothetical test scores (at least 30 scores). Arrange the data in a regular and a cumulative frequency distribution. Discuss the logic of arranging the data in these types of distribution.

(4) Collect several examples of different graphical techniques for presenting data. Categorize these examples in terms of a bar graph, histogram, and polygon. Discuss the advantages of presenting data in these various forms.

(5) Discuss a relative frequency distribution and exemplify graphically how this technique can be used to compare two sets of data.

(6) Identify and describe several properties of polygons.

(7) Define the basic measures of central tendency, and discuss the advantages and limitations of each type of measure.

(8) From a set of data determine the mean, median, and mode.

(9) Define and give an example of nominal, ordinal, interval, and ratio level of measurement.

(10) Explain the concept of variability and the purpose of measures of variability.

(11) Discuss the significance of sigma (Z-scores) and standard (T-scores).

(12) For a set of data, show how to find the range and the standard deviation.

(13) Discuss the essential characteristics of the mathematically defined normal distribution (normal curve).

(14) Demonstrate how to interpret a table that gives the area between various points on the normal curve.

(15) Draw an example of several normal distributions on a single graph which illustrate normal distributions with different means and different standard deviations.

(16) Locate on a normal curve base line plus and minus 1, 2, and 3 standard deviations. Indicate the percent of area under the normal curve between the mean and each of the above standard deviations.

(17) Define and discuss what is meant by percentile rank.

Suggested Resources

Best, John N. Research in Education. Englewood Cliffs, New Jersey: Prentice-Hall, 1970.

Borg, Walter R., and Meredith D. Gall. Educational Research. New York: David McKay Company, 1971.

Freund, John E. Modern Elementary Statistics. Englewood Cliffs, New Jersey: Prentice-Hall, 1973.

Krahmer, Edward, and Clyde Morris. Reading and Evaluating Educational Research. New York: Macmillan, 1974.

Mouly, Geroge J. The Science of Educational Research. New York: Van Nostran Reinhold, 1970.

Naiman, Arnold and others. Understanding Statistics. New York: McGraw-Hill, 1972.

Popham, James W., and Kenneth A. Sirotnik. Educational Statistics Use and Interpretation. New York: Harper and Row, 1973.

Schmidt, Marty J. Understanding and Using Statistics Basic Concepts. Lexington, Massachusetts: D. C. Heath, 1975

Welkowitz, Joan and others. Introductory Statistics for the Behavioral Sciences. New York: Academic Press, 1971.

Upon successful completion of assigned activities, proceed to Lesson 2.

RESEARCH DESIGN IN VOCATIONAL EDUCATION

Lesson Two: Correlation and Prediction

Objective

Upon the completion of this lesson, the student will be able to demonstrate an understanding of the correlation and logic or regression analysis.

Overview

One of the goals of science is to discover relationships between various phenomena and on the basis of this relationship be able to make predictions about one variable from a knowledge of a second variable. The relationship between two or more sets of data can be defined by the concept of correlation. Coefficient of correlation expresses in mathematical terms the degree of relationship between any two variables.

An important application of correlational analysis is that of prediction. When the relationship between two sample sets of variables has been established, it is possible to make predictions about one of the variables from a knowledge of the other variable. To be of significant value in prediction, between two variables the level of correlation must be fairly high; the closer the relationship the more accurate the prediction possible.

Suggested Activities

(1) Define and discuss the term correlation.

(2) Give examples from everyday experiences that demonstrate both negative and positive correlation between variables.

(3) Prepare a scatter-plot diagram for some set of paired observations and explain how the chart shows direction and degree of relation.

(4) Explain the purpose and fundamental characteristics of correlation coefficients.

(5) Demonstrate the ability to compute and interpret the Pearson r for a group of paired observations.

(6) Enumerate the basic assumptions that underlie the use of the Pearson r.

(7) Discuss the importance of correlation in making predictions.

(8) Discuss and describe the importance of regression analysis.

(9) On a scatter-plot, draw an example of a regression line and demonstrate how it can be used to predict a second variable if one variable is given.

Suggested Resources

Best, John N. Research in Education. Englewood Cliffs, New Jersey: Prentice-Hall, 1970.

Borg, Walter R., and Meredith D. Gall. Educational Research. New York: David McKay Company, 1971.

Freund, John E. Modern Elementary Statistics. Englewood Cliffs, New Jersey: Prentice-Hall, 1973.

Krahmer, Edward, and Clyde Morris. Reading and Evaluating Educational Research. New York: Macmillan, 1974.

Mouly, George J. The Science of Educational Research. New York: Van Nostran Reinhold Company, 1970.

Naiman, Arnold and others. Understanding Statistics. New York: McGraw-Hill, 1972.

Popham, James W., and Kenneth A. Sirotnik. Educational Statistics Use and Interpretation. New York: Harper and Row, 1973.

Schmidt, Marty J. Understanding and Using Statistics Basic Concepts. Lexington, Massachusetts: D. C. Heath, 1975.

Welkowitz, Joan and others. Introductory Statistics for the Behavioral Sciences. New York: Academic Press, 1971.

Upon successful completion of assigned activities, proceed to Lesson 3.

RESEARCH DESIGN IN VOCATIONAL EDUCATION

Lesson Three: Laws of Probability and Strategies of Inferential Statistics

Objective

Upon the completion of this lesson, the student will be able to write or present orally the rationale for inferential statistics and the basic strategy on which inferential statistics is founded.

Overview

Directly or indirectly, the concept of probability plays an important role in all problems of science, business, and everyday life which in any way involve an element of uncertainty. Hence, if statistics are identified with the art, or science of making decisions in the face of uncertainty, it follows that questions concerning probabilities, their meaning, their determination, and their mathematical manipulation are basic to any treatment of statistics.

One of the fundamental aims of research is to discover principles that have universal applications. In many research studies it is not possible or practical for the researcher to collect data from the total population; therefore, it becomes necessary to follow appropriate procedures in collecting representative data from the population and then to rely on inferential statistics to make judgments regarding the total population.

Inferential statistical procedures aid the researcher in this task by allowing him to determine with what mathematical probability the relationships discovered in a sample actually exist in the total population. Inferential statistics include not only methods for making inferences about populations, but also methods for evaluating the likelihood that they are in error. These methods require a means of describing and measuring uncertainty; this is the function of probability statements.

Suggested Activities

(1) Define and discuss probability.

(2) On a nationally normed test, what is the probability that a randomly selected student will score at or above the mean; will score in the top 10 percent of the group? Explain.

(3) Discuss the meaning of a random sample and its importance in a statistical test.

(4) Discuss and differentiate between a population distribution, sample distribution, and a sampling distribution.

(5) Define the term "standard error of the mean" and indicate its importance in statistical analysis.

(6) The sampling distribution is a key to inferential statistics. Explain.

Suggested Resources

Best, John N. Research in Education. Englewood Cliffs, New Jersey: Prentice-Hall, 1970.

Borg, Walter R., and Meredith D. Gall. Educational Research. New York: David McKay, 1971.

Freund, John E. Modern Elementary Statistics. Englewood Cliffs, New Jersey: Prentice-Hall, 1973.

Krahmer, Edward, and Clyde Morris. Reading and Evaluating Educational Research. New York: Macmillan, 1974.

Li, Jerome C. R. Statistical Inference. Ann Arbor, Michigan: Edwards Brothers, 1964.

McCollough, Celeste, and Van Atta Loche. Statistical Concepts. New York: McGraw-Hill, 1963.

Mouly, George J. The Science of Educational Research. New York: Van Nostran Reinhold Company, 1970.

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Popham, James W., and Kenneth A. Sirotnik. Educational Statistics Use and Interpretation. New York: Harper and Row, 1973.

Schmidt, Marty J. Understanding and Using Statistics Basic Concepts. Lexington, Massachusetts: D. C. Heath and Company, 1975.

Spence, Janet T. and others. Elementary Statistics. New York: Appleton-Century-Crofts, 1968.

Welkowitz, Joan and others. Introductory Statistics for the Behavioral Sciences. New York: Academic Press, 1971.

Upon successful completion of assigned activities, proceed to Lesson 4.

RESEARCH DESIGN IN VOCATIONAL EDUCATION

Lesson Four: Hypothesis Testing - Parametric Statistics

Objective

Upon the completion of this lesson, the vocational education student will be able to write or present orally (1) the logic of hypothesis tests; (2) the underlying assumptions for parametric statistics; (3) the possibility of two types of errors in hypothesis tests; and (4) an outline of basic procedures involved in conducting a hypothesis test.

Overview

Hypothesis testing is a term applied to a whole family of inferential methods that are used to draw conclusions about populations based on observations of samples. Inferential statistical procedures aid the researcher by allowing him/her to determine with what mathematical probability the relationships discovered in a sample actually exist in the total population. Hypothesis tests can be used to examine cause and effect relations; they can be used to determine the likelihood that groups are really different or just appear to be different through chance factors.

It is important that the researcher keep in mind that one does not prove a hypothesis to be true or false but only tenable or untenable. Statistical decisions are based on laws of probability and do not absolutely prove or disprove a "truth."

Suggested Activities

(1) Explain the purpose and logic involved in testing hypotheses.

(2) Describe a simple hypothesis test (Z-test) that can be used when population parameters are known.

(3) Describe a t-test and the underlying assumptions for this test.

(4) Discuss the significance of alpha level as it applies to hypothesis testing.

(5) Demonstrate that you can interpret the table that shows the critical values of a student's t-distribution.

(6) Discuss the meaning of the "sampling distribution of the difference between two means."

(7) Explain the concept of independent and dependent variables as it applies to statistics.

(8) Discuss the meaning and significance of rejecting or failing to reject the null hypothesis.

(9) Discuss the meaning of type I and type II errors in hypothesis testing.

(10) Outline the steps involved in independent samples experiments to examine the effects of variable A on variable B.

(11) In a two sample t-test, discuss the significance of the F-ratio.

(12) Explain an advantage of the Analysis of Variance (ANOVA) over the t-test.

Suggested Resources

Best, John N. Research in Education. Englewood Cliffs, New Jersey: Prentice-Hall, 1970.

Borg, Walter R., and Meredith D. Gall. Educational Research. New York: David McKay Company, 1971.

Freund, John E. Modern Elementary Statistics. Englewood Cliffs, New Jersey: Prentice-Hall, 1973.

Krahmer, Edward, and Clyde Morris. Reading and Evaluating Educational Research. New York: Macmillan, 1974.

Mouly, George J. The Science of Educational Research. New York: Van Nostran Reinhold Company, 1970.

Naiman, Arnold and others. Understanding Statistics. New York: McGraw-Hill, 1972.

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Schmidt, Marty J. Understanding and Using Statistics Basic Concepts. Lexington, Massachusetts: D. C. Heath, 1975.

Spence, Janet T. and others. Elementary Statistics. New York: Appleton-Century-Crofts, 1968.

Welkowitz, Joan and others. Introductory Statistics for the Behavioral Sciences. New York: Academic Press, 1971.

Upon successful completion of assigned activities, proceed to Lesson 5.

RESEARCH DESIGN IN VOCATIONAL EDUCATION

Lesson Five: Hypothesis Testing - Nonparametric Statistics

Objective

Upon the satisfactory completion of this lesson, the student will be able to differentiate between parametric and nonparametric tests. Specifically the student will be able to identify some basic applications of the Chi Square statistic and have an awareness of other nonparametric statistical tests.

Overview

Nonparametric statistical tests have many applications in research studies. However, it should be noted that these tests are not as powerful as the parametric test. One of the reasons for this difference is the fact that less stringent assumptions are needed with nonparametric techniques. One of the specific advantages of the nonparametric tests is that they can be used with distribution free data. They also can be used with data at the nominal and ordinal level of measurement.

As has been emphasized before, it is important that the researcher develop a sound research plan and select appropriate statistical tools prior to the collection of data. Different statistical tools will indicate, to some extent, the type of data that will be required for the study.

Suggested Activities

(1) Discuss the basic difference in the underlying assumptions for parametric and nonparametric tests.

(2) Describe the Chi Square statistic in terms of data requirements.

(3) From a hypothetical set of data, state the hypothesis for the Chi Square test.

(4) List some limitations for the Chi Square test.

(5) Prepare a list of several other nonparametric tests and give a basic situation in which they can be used.

Suggested Resources

Best, John N. Research in Education. Englewood Cliffs, New Jersey: Prentice-Hall, 1970.

Borg, Walter R., and Meredith D. Gall. Educational Research. New York: David McKay Company, 1971.

Freund, John E. Modern Elementary Statistics. Engelwood Cliffs, New Jersey: Prentice-Hall, 1973.

Krahmer, Edward, and Clyde Morris. Reading and Evaluating Educational Research. New York: Macmillan, 1974.

McCollough, Celeste, and Van Atta Loche. Statistical Concepts. New York: McGraw-Hill, 1963.

Mouly, George J. The Science of Educational Research. New York: Van Nostran Reinhold Company, 1970.

Naiman, Arnold and others. Understanding Statistics. New York: McGraw-Hill, 1972.

Popham, James W., and Kenneth A. Sirotnik. Educational Statistics Use and Interpretation. New York: Harper and Row, 1973.

Schmidt, Marty J. Understanding and Using Statistics Basic Concepts. Lexington, Massachusetts: D. C. Heath and Company, 1975.

Welkowitz, Joan and others. Introductory Statistics for the Behavioral Sciences. New York: Academic Press, 1971.

Upon completion of the assigned activities in this module, you should be ready to take the Module Posttest. See your instructor for directions and measurement criteria.

RESEARCH DESIGN IN VOCATIONAL EDUCATION

MODULE PRE/POSTTEST

Student_____

Instructor_____

Date_____

Student: The pre/posttest is designed to assess your knowledge of research design in vocational education. Since this module is an individualized and competency-based learning device, you will need to study only those lessons that are presented on the basis of your response to this test.

1. There are four basic levels of measurement and each level has certain characteristics or properties. Listed below are the four levels of measurement and various properties that apply to these different levels. Indicate the property or properties that apply to a given level of measurement by drawing a circle around the appropriate letters adjacent to a given level of measurement.

Level of Measurement		Properties
Ordinal	A B C D	A Order among classes
Ratio	A B C D	B Discrete classes
Nominal	A B C D	C An absolute zero
Interval	A B C D	D Equal intervals

2. What term would apply to a distribution of scores that has a great many low scores and a few extremely high scores?

3. If a researcher desires to match pairs of high school sophomores according to intelligence, but finds that the students have one of three different types of intelligence scores, each with a different mean and standard deviation, what relatively simple statistical process could be used to match the students?

4. As a general rule the _____ will provide the most sensitive index of central tendency.

Pre/posttest (continued)

5. Discuss the three basic measures of central tendency, and indicate the type of data that can be used with each.

6. Discuss the meaning of standard deviation and its value in statistics.

7. What would be the nature of a set of data if the standard deviation is zero?

8. In the distribution below, what does "94" in the cumulative frequency column have reference to?

SCORE (X)	FREQUENCY (f)	CUMULATIVE FREQUENCY (cf)
10	6	100
9	9	94
8	17	85
7	15	68
6	23	53
5	15	30
4	9	15
3	5	6
2	0	1
1	1	1
0	0	0

9. What does "23" in the frequency column have reference to?

10. The mode for the above distribution is _____.

11. The range for the above distribution is _____.

12. As a general rule, the median is a more descriptive measure of central tendency than is the mean. TRUE or FALSE

13. A population with a larger variance has more diversified observation than one with a smaller variance. TRUE or FALSE

Pre/posttest (continued)

14. The range is one measure of variability. TRUE or FALSE

15. The goal of educational research is to develop a science of behavior for educational situations. TRUE or FALSE

16. With the Pearson r it is possible to determine the cause of the relationship between variables. TRUE or FALSE

17. In the Product Moment Correlation, the coefficient r ranges between _____ and _____.

18. Describe the underlying assumptions for the Pearson r. (Use back of page.)

19. Indicate the type of correlation, positive or negative, if any, that one would expect to find in the following examples:

    a. The intelligence of parents and their offspring

    b. Scholastic success and annual income ten years after graduation

    c. Marks on an examination in physics and mathematical ability

    d. The number of freckles and IQ

    e. Amount of time spent in jail and years of education

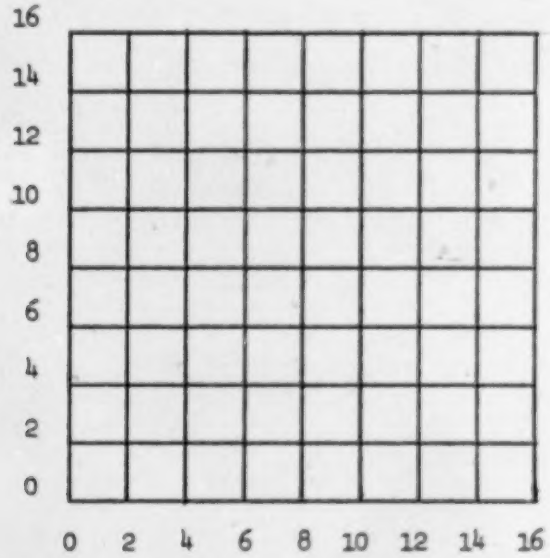
20. Discuss the relationship between the correlation of variables and the ability to use this information to make predictions about one variable when the other variable is known.

Pre/posttest (continued)

21. Plot the data in Table 1 on the graph. Discuss the nature of the correlation that exists between the variables.

Table 1. Set of Data for Test P and Q

Individual	A	B	C	D	E	F	G	H	I	J
Score in Test P	2	3	5	6	6	8	10	10	12	13
Score in Test Q	1	6	7	2	11	9	7	11	14	11



22. Mathematically, there is a very exact process of determining the intercept and the slope of a regression line (prediction line) through the scatter plot. Without computing the regression formula, draw a regression line which you think would approximate the computed regression line. From this regression line, what would be the best estimate of the score on test Q if a student from the same population received a score of 9 on test P?

Pre/posttest (continued)

23. By statistically significant, it is meant that the observed phenomenon represents a significant departure from what might be expected by chance alone. TRUE or FALSE

24. As a general rule in educational statistics, a "rare" event is an "event" which has a probability not greater than .05 or .01 of being true. TRUE or FALSE

25. The mean of several sample means drawn from a population will be close to the population mean even though an individual sample mean may vary quite widely from the population mean. TRUE or FALSE

26. The standard deviation of the sampling distribution of means is designated as _____.

27. The variability between several large sample means drawn from a population would be greater than would the variability between several small sample means drawn from a population. TRUE or FALSE.

28. When many large samples are drawn from the same population, the sampling distribution of means assumes approximately the form of a normal distribution. TRUE or FALSE

29. What condition must be satisfied for a sample to be considered randomly drawn?

30. The degree to which inferences drawn from sample data hold true is in large measure a function of the equivalence between the sample and the particular population to which the inference is to be applied. TRUE or FALSE

31. As the size of the sample increases, the distribution of the means of all possible samples of the same size drawn from the same population becomes more and more like a normal distribution. TRUE or FALSE

32. The purpose of a statistical test of a hypothesis is to check the contention against some obtained facts. TRUE or FALSE

33. The mean of the means of all possible samples of the same size drawn from the same population is equal to the mean of that population. TRUE or FALSE

34. The most widely used statistical index of variability is know as the _____.

35. Explain the general purpose and logic involved in testing hypotheses.

Pre/posttest continued)

36. Describe the basic applications of the Z-test and student's t-test of significance.

37. Discuss the meaning of the alpha level as it applies to tests of significance.

38. Hypotheses are suppositions, presumed to be true for subsequent testing. TRUE or FALSE

39. If a difference between two means is so large that it cannot be due to sampling variability, it is called a _____difference.

40. An event with a probability of .05 is actually expected to occur, on the average, _____ times in every _____ times that the same experiment is performed, even if the null hypothesis is correct.

41. Suppose that you have developed a new scientific theory which you hope will gain you fame and fortune. Being a properly cautious scientist, you test out your theory by collecting data from a sample drawn randomly from the specified population and you treat the data according to the specified plan. The possible outcomes of the statistical test and the possible true state of affairs can be indicated by the table as shown below. Indicate in each of the cells the possible results of the test.

True State of Affairs

Your Decision	H_o is true	H_o is False
Retain H_o		
Reject H_o		

Pre/posttest (continued)

42. With large sample sizes the t distribution is approximately the same as the z distribution. TRUE or FALSE

43. The probability of a type I error is exactly equal to the criterion of significance, but the probability of a type II error is not so conveniently determined. TRUE or FALSE

44. To test if a sample mean is different than the known population mean a _____ distribution would be used.

45. In some instances, when making inferences about a population mean from a sample mean, it is desirable to state that the mean lies within a certain _____ at a certain level of _____.

46. When population parameters are not known it is possible to test the hypothesis that a sample mean is equal to some hypothesized population mean. To perform this test the _____ distribution can be used.

47. Upon what factors does the size of the critical t table value depend?

48. Increasing the sample size will reduce both of the prevalent type of errors. TRUE or FALSE

49. Discuss some properties of nonparametric statistics.

50. Chi Square is a statistical test that can be used with both parametric and nonparametric data. Discuss some properties of the Chi Square Test.

Return this test to your instructor.

ANSWER KEY
MODULE PRE/POSTTEST

Instructor:	Do not reproduce this page in students' booklets. You must retain it for grading and prescriptive purposes. Answers will vary with individuals. A preferred response might be similar to the answer presented.

1. (L1)
Ordinal A B

Ratio A B C D

Nominal A

Interval A B C

2. (L1) Positively skewed

3. (L1) Z-Score

4. (L1) Mean

5. (L1) Mode - Most frequently occurring value. Can be used with nominal-scale data.

Median - Value with half the distribution falling above it and half the distribution falling below it. Appropriate only for data at the ordinal level or higher.

Mean - Sum of all values divided by the number of values. Requires at least interval-level data.

6. (L1) The standard deviation is a measure of variability based on deviations from the mean of the distribution. It is the most commonly used measure of variability. It is useful in describing a distribution's spread. It is expressed in the same units as the original data. It is more stable than other measures of variability. It reflects the value of every observation in the distribution. Its mathematical properties permit its use in complex statistical operations.

Module Pre/posttest Answer Key (continued)

7. (L1) All the scores are the same.

8. (L1) 94 persons received a score of 9 or less.

9. (L1) 23 persons received a score of 6.

10. (L1) The mode of the above distribution is 6.

11. (L1) The range of the above distribution is 9.

12. (L1) False

13. (L1) True

14. (L1) True

15. (L1) True

16. (L2) False

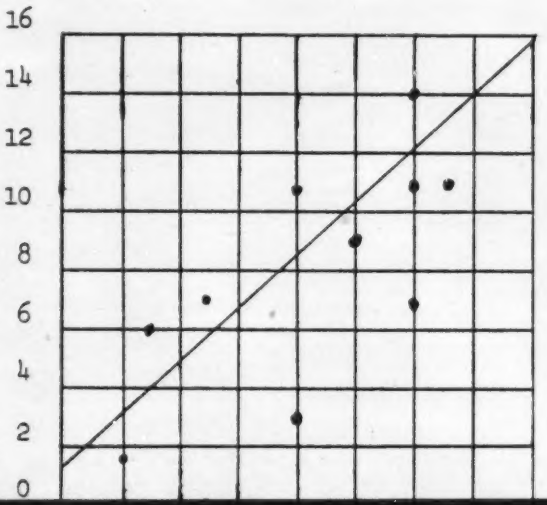
17. (L2) -1 and +1

18. (L2) The data on variables must be at least interval-scale data. The relation between variables X and Y must be approximately linear. The variances of the two distributions must be approximately equal.

19. (L2)
a. Positive
b. Positive
c. Positive
d. Zero correlation
e. Negative

20. (L2) Prediction and correlation are closely related. The presence of a zero correlation between two variables X and Y may usually be interpreted to mean that they bear a random relation to each other. When variables are correlated, however, we can make an educated guess about the value of Y given the value of X. The greater the absolute value of correlation between X and Y, the more accurate the prediction of one variable from the other. If the correlation between X and Y is either -1 or +1, perfect prediction is possible.

21. (L2) Positive Correlation



Module Pre/posttest Answer Key (continued)

22. (L2) If a student receives a score of 9 on test Q, the best guess of his score on test P would be approximately 9.

23. (L3) True 24. (L3) True 25. (L3) True 26. (L3) The standard error of the mean.

27. (L3) False 28. (L3) True 29. (L3) That every member of the population would have an equal opportunity of being selected.

30. (L3) True 31. (L3) True 32. (L3) True 34. (L3) Standard deviation

35. (L4) Hypotheses tests are designed to help the researcher draw conclusions regarding the relationship between variables. The logic of these tests are based upon the law of probabilities. By employing statistical tests, an attempt is made to determine if the observed difference between two variables should be attributed to chance; or in fact, is the difference between the variables great enough that the difference should be attributed to something other than chance.

36. (L4) The Z-test is a simple test that is designed to determine if there is a significant difference between sample data from a population and the population parameters. This test makes use of the normal population distribution.

The t-test is designed to test for differences between two independent samples, repeated measure experiments, counter balanced repeated-measure experiments, etc. This test is based upon the sampling distribution of the difference between two means or the student's t-distribution.

37. (L4) The alpha level has reference to a probability value at which the researcher is willing to conclude that the results of a test are statistically significant. If the researcher sets the alpha level equal to .05, there are 5 chances out of 100 that the difference between the variables in the test could be attributed to sampling error or other chance factors. In most behavioral science research .05 and .001 are selected as the alpha level.

38. (L4) True 39. (L4) Significant 40. (L4) 5 times in every 100

41.

	True State of Affairs	
Your Decision	H_o is True	H_o is False
Retain H_o	Correct decision	Type II error
Reject H_o	Type I error	Correct error

Module Pre/posttest Answer Key (continued)

42. (L4)	True	43. (L4)	True	44. (L4)	Z-test	45. (L4)	Interval at a certain level of significance
46. (L4)	t-test	47. (L4)	Sample size or degrees of freedom			48. (L4)	True

49. (L5) Nonparametric statistics can be used with data at less than the interval level and also with data in which the population distribution is not known. Many nonparametric methods have special appeal since they are easier to calculate mathematically. Not only are these methods simpler as far as arithmetical details are concerned, many of them are easier to understand and explain than are the parametric techniques. However, since less stringent assumptions are associated with these tests, they are considered to be less powerful than parametric statistics.

50. (L5) The Chi Square Test can be used with both parametric and nonparametric data, however, its primary application is with nonparametric statistics. It can be used with data at the nominal level of measurement. One specific application involves count data to determine if there is a significant difference between the observed or actual count falling in given categories and the actual frequencies expected to fall in the various categories.

MODULES -- COMMON CORE CURRICULUM FOR VOCATIONAL EDUCATION

Category A: Introduction to Vocational Education

- A-1 History, Philosophy, and Trends in Vocational Education
- A-2 Scope, Function, and Organization in Vocational Education
- A-3 Vocational Legislation
- A-4 Assessing the Job Market and Employment Trends

Category B: Cooperative Relationship

- B-1 Rationale for Cooperative Relationships
- B-2 Advisory Councils
- B-3 Cooperative and Work Experience Programs

Caregory C: Vocational Students

- C-1 Promoting Vocational Education and Recruiting Eligible Students for Vocational Education
- C-2 Assessing Students' Personal Characteristics
- C-3 Guidance and Counseling
- C-4 Assisting Students with Special Needs in Vocational Education Program
- C-5 Assessing the Needs of the Disadvantaged Student
- C-6 Developing Student Leadership Qualities in Vocational Education Programs
- C-7 Student Organizations

Category D: Administration and Supervision

- D-1 Fiscal Management of a Vocational Education Program
- D-2 Writing a Vocational Education Project/Budget
- D-3 Record Keeping in Vocational Programs
- D-4 Conference Leadership
- D-5 Selection, Supervision, and Evaluation of Personnel
- D-6 School Law and Its Relationship to Vocational Education
- D-7 Staff Development
- D-8 Implementation of Change

Category E: Curriculum Design in Vocational Education

- E-1 Developing a Curriculum Design in Vocational Education
- E-2 Applying Learning Theory to Vocational Education
- E-3 Instructional Strategies

Category F: Stages and Structure of Curriculum Development

- F-1 Theories in Curriculum Development
- F-2 Building a Curriculum for Vocational Education
- F-3 Applying Curriculum Specifics to Vocational Education
- F-4 Safety

Category G: Evaluation and Research

- G-1 Evaluation Models
- G-2 Evaluation Procedures for Local Programs
- G-3 Introduction to Research Procedures in Vocational Education
- G-4 Research Design in Vocational Education
- G-5 Development of a Research Proposal in Vocational Education